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April 26, 1994

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, D.C. 20554

Re: Notice of Ex Parte Contact
PR Docket No. 93-61

Dear Mr. Caton:

Pursuant to Section 1.1206 of the Commission's Rules, notice is hereby given of an ex parte communication regarding the above-referenced proceeding. The instant notice is being submitted in duplicate.

On April 22, 1994, the undersigned and John J. McDonnell of this office, as counsel to MobileVision, L.P., met with Rosalind K. Allen, Chief, Rules Branch, Private Radio Bureau to discuss matters relating to the issues in this proceeding. The content of the discussion is reflected in the attached material.

Please associate this material with the record in this proceeding.

Sincerely,

REED SMITH SHAW & McCLAY

Marnie K. Sarver

Marnie K. Sarver

Enclosures

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Response to Hatfield Associates, Exhibit 1

of

Pinpoint's Reply Comments on Ex Parte Presentations

I. Summary

Pinpoint has touted the strengths and benefits of its ARRAY system throughout these proceedings. On January 24, 1994, Pinpoint submitted to the Commission a report of Hatfield Associates ("Hatfield Report") purporting to confirm those strengths and benefits based on an analysis of the results of Pinpoint's Potomac River test of the ARRAY system. MobileVision in Annex 5 of its Further Comments, dated March 15, 1994 analyzed Hatfield Report and found that Pinpoint's ARRAY system has a limited range and low jamming margin. Pinpoint in its Reply Comments of March 29, 1994 roundly criticizes MobileVision's Annex 5 claiming that "...MobileVision has misinterpreted and distorted the Hatfield Report and has committed fundamental engineering mistakes to reach its conclusions"[1]. This paper is in response to the Further Reply Comments of Pinpoint. Because the matters at issue are fundamental to this proceeding and the Commission's evaluation of technical proposals before it, MobileVision is constrained to address its concerns again. The record here is complicated. It need not be made more so by failure to recognize that the basic laws of physics provide a "level playing field" upon which every system may be tested and evaluated.

MobileVision steadfastly stands by its previous analysis, and reiterates that, in fact, the Pinpoint system has limited range and poor jamming margin (i.e., resistance to interference). Furthermore, MobileVision's previous analyses have reliably predicted the operation of Pinpoint's system in certain basic respects. Indeed, it is Pinpoint and Hatfield Associates who have made fundamental errors. As shown in this paper, the "theory" espoused by Hatfield is not generally accepted in the technical literature regarding spread spectrum techniques (see section VI, References, infra). Thus, MobileVision submits that Hatfield Associates and/or Pinpoint should come forward with

[1]Reply Comments of Pinpoint Communications, Inc. on Comments on Ex Parte Presentations, March 29, 1993, p.36.

their sources of authority and the fundamental equations upon which they rely to reach their conclusions.

Hatfield Associates' Response appears to be inconsistent with fundamental knowledge on the subject of processing gain and sensitivity as applied to spread spectrum systems. In their response, Hatfield Associates have used a formula for processing gain which attempts to show, inter alia, that the processing gain of the Pinpoint system is higher than in fact it is. Based on their flawed definition, they then draw conclusions about their system's range, finally proclaiming that the Pinpoint system's range is greater than what in reality it can be. As importantly, its presentation on sensitivity would attribute a greater resistance to interference, and thus an increased ability to share with the other users of the LMS band, than is actually the case.

Finally, the Potomac River test bed of Pinpoint and Hatfield Associates, which purported to demonstrate the ARRAY system's performance, is best-case geography contrary to the assertions of those parties. The route does not traverse any built-up area as it is either within National Parks or along the Potomac River. In fact, at any point on the test route, there probably are at least three transmitter sites which are within radio line-of-sight, hardly a worst case scenario or representative of "urban canyons".

II. Pinpoint and Hatfield should make known the authorities and fundamental equations upon which their analyses rely.

There appears to be a certain level of consistency between Hatfield Associates and MobileVision analyses in that both use the same terms of art and discuss the same basic elements of spread spectrum systems. However, Hatfield's conclusions about the basic relationships between these elements are fundamentally inconsistent with any technical literature known to MobileVision. MobileVision has prepared its analyses using the work of sources that are generally accepted in the industry and cited these references where necessary and appropriate. In fact, Hatfield in its latest response does not reveal its references but simply relies on *ad hoc* calculations. At a minimum, Hatfield should provide such references.

III. MobileVision stands by its previous analysis and believes that Pinpoint's system has a limited range and low jamming margin

In describing the results of the Potomac River Test, the Hatfield Report (page 5-7) states that "...[Figure 6] shows that the received signal level was above -85 dBm, the nominal Transmodem receiver sensitivity, at all but five points in the array." Hatfield has now revised its value for receiver sensitivity to -100 dBm.[2] In either case, Pinpoint's system has a low jamming margin, and, thus, will be susceptible to interference. In addition, Pinpoint's system has a more limited range than Hatfield indicates.

A. Sensitivity

The following analysis discusses the relationship between sensitivity[3] and jamming margin.[4] Sensitivity analysis is very basic. The fundamental relationships are restated below for the benefit of those who are not so familiar with them.

The sensitivity of a direct sequence spread spectrum receiver is calculated as follows:

Sensitivity = thermal noise + noise figure - processing gain + output signal to noise ratio, (in decibels)[5] **(1)**

---

[2] Contrary to Hatfield's assertion (p.2 of Hatfield's Response), MobileVision misconstrued nothing with respect to Hatfield's original -85 dBm figure. Hatfield's Report presented the -85 dBm figure as the nominal Transmodem receiver sensitivity and it did not indicate that that figure was based on the "expected interference environment." Thus, exactly what the -85 dBm value represents appears now to be unclear. In addition, Hatfield admits in the same report that Pinpoint's system is in need of improvement by stating that "...commercial Transmodems are expected to have better sensitivity."

[3] *Sensitivity* is the weakest signal a receiver can reliably detect. The range of a radio system is affected by receiver sensitivity, transmitted power and other factors.

[4] *Jamming Margin* can be thought of as the residual advantage of a receiver against interference when taking into account required signal to noise ratios and other losses.

[5] *See* section VII, "Derivation of Sensitivity Equation", infra, for a mathematical derivation of this equation.

where, **thermal noise** is the amount of noise due to temperature (the minimum noise floor which can be expected), **noise figure** is a measure of the receiver's contribution to noise, **processing gain** is the theoretical maximum advantage the receiver has against interfering signals, **and output signal to noise ratio** is the minimum ratio between output signal and output noise which is required to properly detect the signal. Equation (1) follows from the definition of Noise Figure which can be found in reference material or elementary texts on the subject of radio engineering.[6]

Jamming margin is defined as the processing gain minus the output signal to noise ratio.[7]

Thus,

Sensitivity = thermal noise + noise figure - jamming margin,

the foregoing expressed in dB.

The Hatfield Associates Response states on page 3, "Laboratory measurements show that the overall noise figure is less than 6 dB and the sensitivity of the experimental receivers is approximately -100 dBm or lower." Thus, using Hatfield's values, noise figure is 6 dB and sensitivity equals -100 dBm. The amount of thermal noise is a function of temperature and its value is dependent upon the bandwidth within which it is measured.[8] To determine thermal noise we start with the generally accepted figure of -174 dBm/Hz[9], and, adjusting for a 10 MHz bandwidth,[10] we add 70 dB to obtain -104 dBm thermal noise power.

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[6] *See*, for example, "Reference Data for Radio Engineers", Fifth Edition, p. 27-5.

[7] *See* reference 1, equation (24), p. 859, reference 2, equation (13.44), p. 396 and reference 3, equation (10.44), p. 576.

[8] As in a camera lens, the wider the aperture, the more light that enters the camera. Similarly, the wider the bandwidth, the more thermal noise the receiver "sees." Thermal noise is calculated by taking the power spectral density (the noise in a 1 Hz bandwidth) then adjusting for the actual bandwidth used.

[9] This figure is the calculated by the product of Boltzmann's constant and the temperature (290° K) then converted to dBm.

[10] Pinpoint Reply Comments, July 29, 1993, Appendix B, p.15 & p.31

Applying these figures:

$$-100 = -104 + 6 - JM, \text{ dBm, and,}$$

$$-100 = -98 - JM \qquad \textbf{Jamming Margin = 2 dB.}$$

Thus, a sensitivity of –100 dBm is equivalent to an actual jamming margin of 2 dB, in a 10 MHz bandwidth. This is significantly lower than the 23.1 dB figure alleged by Hatfield (see section B, Processing Gain, infra)

Thus it can be seen that with respective sensitivities of -100 dBm for the Pinpoint receiver and -118 dBm for the MobileVision receiver, the MobileVision receiver has an 18 dB advantage in sensitivity. This 18 dB advantage corresponds to approximately three (exactly 2.8) times the range.[11] This is exactly as predicted by the MobileVision analysis[12].

B. Processing Gain

Hatfield Associates defines processing gain as being "...nearly equal to the number of chips in the transmitted sequence times the number of correlator outputs that are averaged together."[13] This definition is inconsistent with the generally accepted principles in the field and Hatfield cites no authority for this definition. Proceeding with this definition, Hatfield Associates calculate the processing gain of Pinpoint's system to be 33.1 dB and the jamming margin to be 23.1 dB. As shown below, these results are inconsistent with the generally expected results.

The definition of processing gain, as given in all references, is the ratio of the spread bandwidth (Bss) to the message bandwidth (Bm),[14]

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[11] This figure assumes worst case propagation loss which is inversely proportional to the 4th power of distance, i.e., 12 dB/octave.

[12] *See* Further Comments of MobileVision, L.P., March 15, 1994, Annex 5, paragraph 1.1; Reply Comments of MobileVision, July 29, 1993, Annex 1.

[13] Reply Comments of Pinpoint Communications, Inc. on Comments on Ex Parte Presentations, March 29, 1993, Exhibit 1, p. 3.

[14] *See* reference 1, equation (12), p. 857 and reference 2, equation (8-5), p. 274.

$$PG \equiv \frac{Spread\ Bandwidth}{Message\ Bandwidth} = \frac{B_{ss}}{B_m}$$

The spread bandwidth, *Bss,* is directly proportional to the chipping frequency, *Fc.*

Since the chipping sequences used in direct sequence spread spectrum systems are of finite length, they will eventually repeat. Each repetition of the sequence can be considered a binary integer (i.e., a bit) in the simple case. Detection of each repetition of the chipping sequence, the receiver yields a bit or message rate of *Fc/L* bits per second, where *L* is the number of chips in the transmitted sequence. The bandwidth required to detect *Fc/L* bits per second, i.e., *Bm*, is directly proportional to *Fc/L*, therefore:[15]

$$PG = \frac{Fc}{Fc/L} = L$$

In fact, the processing gain is also defined as the "ratio of chip rate to the message rate", which is also *L*[16]. Generally, the processing gain is expressed in decibels ("dB") which are simply a convenient way of expressing ratios. Since processing gain *(PG)* equals chipping sequence length (*L)* as shown above, processing gain in decibels is simply:

$$PG = 10\ \log(L)$$

Hatfield Associates state that "It is important to note that the number of bits Pinpoint encodes into each of their 127-chip sequences does not affect the processing gain"[17]. Texts and sources with which MobileVision is familiar state that the number of bits encoded *does* affect processing gain because the post-detection message bandwidth increases (i.e., *Bm* becomes larger) as the data rate increases. If data are encoded into the transmitted sequence, such that 4

[15] ***See*** **reference 3, equation (10.27), p. 555**
[16]***See*** **reference 2, p. 275 and reference 3, equation (10.28), p. 555.**
[17] Reply Comments of Pinpoint Communications, Inc. on Comments on Ex Parte Presentations, March 29, 1993, Exhibit 1, p. 3, Footnote 6.

bits of data are encoded per sequence transmitted as Pinpoint state they do[18], then the message bandwidth required to detect those bits must be four times greater[19], because the data rate is four times faster, hence the processing gain will be four times less. In short, the more information transmitted per unit time the greater the message bandwidth, thus the smaller the processing gain.

Using values from the Hatfield Report we see that the Pinpoint system uses a sequence length, *L* of 127. Conversion to decibels yields 21 dB which would be the maximum theoretical processing gain that Pinpoint can achieve, yet the Hatfield calculations yield 33.1 dB for this figure. If four bits of data are encoded into each sequence then the processing gain is reduced by a factor of 4 (i.e., -6 dB) which yields a *theoretical maximum* processing gain of 15 dB, less than half the 33.1 dB alleged by Hatfield.

A spread spectrum location burst, when transmitted in a practical application, usually consists of several sequences and not just one, i.e., 16 in the Pinpoint burst,[20] 88 in the case of MobileVision. The time of arrival of these individual sequences is averaged in order to reduce the overall time *jitter error.*[21] This averaging process reduces the time of arrival measurement error, but has *no effect on the processing gain* which, as indicated above, is a measure of the *theoretical* advantage the receiver has against interfering signals at a signal to noise ratio which permits signal detection. If the transmission is detected with sufficient signal to noise ratio, then averaging the results of measurements taken of each sequence *will not yield any increase in processing gain,* as alleged by Hatfield, but will only serve to reduce *the time of arrival measurement jitter.* Nothing stated in the Hatfield Response has changed this fundamental fact.

[18] Pinpoint's application for Experimental License, August 1993, states the code length is 127 and that 4 data bits are encoded into each sequence.
[19] *See* any text on the subject of digital communications, e.g., reference 2, chapter 2.
[20] *See* Footnote 13.
[21] In Pinpoint's Reply Comments of March 29, 1994, Exhibit 1, p.3 Hatfield states: "In a 127 chip sequence there can be as many as 127 orthogonal codes." Perhaps Hatfield should read R.C. Dixon, "Spread Spectrum Systems", 2nd Edition, pp. 86-89 or reference 1, p. 881. These sources clearly show that there are no more than 18 *orthogonal* codes in a 127 maximal length sequence. It would be interesting for Hatfield to make their authorities known on this subject.

IV. Potomac River Test Bed

Hatfield Associates, in Exhibit 1 of Pinpoint's Reply Comments (p. 6) state that "MobileVision incorrectly states that the Pinpoint test route through Northern Virginia/District of Columbia test ran 'along the sides of the Potomac' and 'mainly through parks'." There was absolutely nothing incorrect about MobileVision's statement. All points on Pinpoint's test route, as clearly indicated in Figure 3 of Hatfield's Report of January 16, 1994, *are either completely within National Parks or adjacent to the Potomac River*. There is no point along the test route that is in a built-up area, hardly representative of "urban canyons." The best that Hatfield could argue is that its five fixed sites are located atop built-up areas. This, however, provides Pinpoint's test system the advantage of balcony seats while attempting to locate a test vehicle maneuvering around on the stage. There probably is no point on Pinpoint's test route that is not within radio, indeed unassisted visual, line-of-sight with at least three of the fixed sites.

V. Conclusions

All of the points above have previously been explained in detail in MobileVision's Annexes submitted as part of this proceeding. To reiterate, there are basic, fundamental relationships that are beyond question, which govern the operation of spread spectrum receiving systems. It must be observed that all the analysis carried out previously by MobileVision, which assumed the correct jamming margin for the Pinpoint system, produced values that correlated well with Pinpoint's own reported results. The stated (laboratory) sensitivity of the Pinpoint receiver agrees with the low jamming margin. The fundamental relationships of direct sequence spread spectrum signaling show that the Pinpoint receiver has a low jamming margin of about 2 to 5 dB, *not* 23.1 dB. This, in fact, will restrict the range to that calculated by MobileVision; nothing stated thus far has changed that fact.

In sum, Hatfield's analysis is flawed in that it does not reflect the limited range and low jamming margin of Pinpoint's ARRAY system MobileVision stands by its previous analyses with respect to those characteristics. Pinpoint's test bed in

Washington, DC is not representative of "built up areas" or "urban canyons" since it mainly traverses National Parks and the banks of Potomac River, thus is not a credible test and should be discounted.

VI. References

1. R L Pickholtz, D L Schilling and L B Miltstein,"Theory of Spread-Spectrum Communications - A Tutorial", IEEE Trans. on Comms., Vol. Com-30, No. 5. May 1982.
2. G R Cooper, "Modern Communications and Spread Spectrum", International Edition, McGraw-Hill, 1986.
3. Bernard Sklar, "Digital Communications, Fundamentals and Applications", Prentice Hall, 1988

VII. Derivation of Sensitivity Equation

The following derivation shows how, from the definition of noise figure the sensitivity of a receiver is calculated. As is shown in elementary texts on the subject[22], The noise figure, *F* is defined as follows:

$$F = \frac{Pi/Ni}{Po/No}$$

where,

F is the Noise Figure,

Pi is the input Power, *Po* is the output Power and,

Ni is the input Noise Power, *No* is the output noise power.

To make the derivation easier to follow, we rename *Pi* to *Ps,* the minimum input signal power that can be detected (i.e., sensitivity), *Ni* (the thermal noise power) to *Pn*, and *Po/No* (the output signal to noise ratio) to *SNRo*. Thus with these changes the equation becomes:

$$F = \frac{P_s/P_n}{SNR_o}$$

Rearranging we obtain,

[22] *See*, for example, "Reference Data for Radio Engineers", Fifth Edition, p. 27-5.

$$P_s = P_n\ F\ SNR_o$$

Now, the thermal noise power can be expressed thus;

$$P_n = k\ T_o\ B_m$$

where *k* is Boltzmann's constant, and *To* is temperature in degrees Kelvin (usually taken as 290°).

From reference 1 equation (23), and all other references as well, (see section VI, <u>supra</u>) processing gain, *PG* is defined as follows:

$$PG = \frac{B_{ss}}{B_m}$$

where, *Bss* is the spread bandwidth and *Bm* is the post detection bandwidth. Thus it follows that:

$$B_m = \frac{Bss}{PG}$$

Substituting for *Bm* we get:

$$P_s = k\ T_o\ \frac{Bss}{PG}\ F\ SNR_o$$

Note that conversion to decibels yields the sensitivity equation:

$$S = (K + B_{ss}) + F - PG + SNR_o$$

where *S* is sensitivity, *K* is Boltzmann's (constant expressed in decibels), *(K+Bss)* is the thermal noise in bandwidth *Bss* , *F* is the noise figure, *PG* is the processing gain, and *SNRo* is the post detection or output signal to noise ratio, all expressed in dB (compare with equation (1.), <u>supra</u>).

Rearranging the terms above we get:

$$S = (K + Bss) + F - (PG - SNR_o)$$

Since the jamming margin[23] *(JM)* is defined to be the processing gain minus the output signal to noise ratio, *(PG-SNRo)* the above equation can be rewritten as:

$$S = (K + Bss) + F - JM$$

Thus,

Sensitivity = thermal noise + noise figure - jamming margin,

the foregoing expressed in dB.

[23] *See* reference 1, equation (24), p. 859, reference 2, equation (13.44), p. 396 and reference 3, equation (10.44), p. 576.

Review of Positions of LMS Commenters

re:

PR Docket 93-61

Prepared by MobileVision, L.P.

I. Summary

The record presented thus far in this proceeding has made crystal clear that time sharing and direct overlay sharing techniques are not viable options given today's state of the technological art. No provider has built or thoroughly tested such a system thus no factual evidence exists that such techniques are workable. Pinpoint, the main proponent of time sharing, has not adequately demonstrated by either analysis or test, that their system withstands the rigors of sound engineering design and thus has offered the least credible of solutions. Conversely, Air Touch Teletrac ("Teletrac"), having abandoned their long standing conviction that co-channel exclusivity is absolutely necessary, has dramatically reduced their credibility by offering a "compromise" proposal which now alleges that sharing of the reverse location channel on a direct overlay basis is feasible, however, this is conditioned upon additional exclusive bandwidth being provided and only for two providers.

The dilemma is clear: four systems currently exist each with dissimilar design. Can they work in a total sharing environment? The only solution, MobileVision submits, is allocation of separate frequencies to each. MobileVision, Southwestern Bell Mobile Systems ("SBMS") and even Teletrac until January 1994 as well as outside experts such as Dr. R. Pickholtz and Virginia Tech., have favored such an approach and their comments generally reflect agreement on this fact. The disagreement stems largely from concerns regarding the *amount* of spectrum to be allocated. At the extreme position is Pinpoint who loudly argue that even 8 MHz is not sufficient for their needs and would have the entire 26 MHz of spectrum to implement a *data communication* system.

The wisdom of the allocation and rule made in 1974 seems to have been lost in the rhetoric and vitriol of the current proceeding. The forefathers clearly understood

these frequencies could not be easily shared, thus wisely allocated two frequencies permanently and exclusively per market.. However, because the very existence of AVM providers who have built systems in conformance with the original rules now hangs in the balance, the technical facts cannot be ignored nor made secondary to lobbying pressures of misinformed and misguided parties whose claims are not backed by rigorous scientific fact. There has been much misrepresentation, that it is likely to have made the Commission's job even more difficult, however, these distorted facts must be ignored. Adoption of time sharing or direct overlay sharing will cause devastation of the spectrum and will literally choke the wideband LMS industry to death thus denying the public of valuable services such as IVHS, stolen vehicle recovery, emergency roadside services and others.

MobileVision has put forth the evidence that supports the long standing principles of the NPRM which are generally supported by others. Throughout these proceedings, Pinpoint has been the *solitary* supporter of time shared spectrum yet has not offered a single fragment of factual evidence that such an approach is viable. They have retained a firm, Hatfield Associates, which has whose analysis indicates a lack of basic understanding of the fundamentals of spread spectrum radio location systems. In fact, Pinpoint, having built a system *not* in compliance with the current rules, would now use the regulatory process to impose its flawed design upon the other providers who have. Should a 20 year old rule be changed to accommodate a system that doesn't even meet the interim rules? MobileVision submits it should not.

Having performed thorough marketing research, MobileVision has found that vehicle location, *per se*, simply is not a viable offering. One need only study Teletrac's lack of success to see that vehicle location alone is not an effective offering.

The facts presented in this proceeding cause us to conclude that:

- MobileVision, SBMS, and Teletrac along with the experts of Virginia Tech. and Dr. R. Pickholtz agree that time sharing is not feasible. Only Pinpoint supports time sharing;
- Time sharing is inefficient, and precludes important ancillary services;

- Pinpoint's system is the most fragile of all, requires the highest transmitted mobile and fixed site power and will interfere with *every* other user of the band including Part 15 devices;
- MobileVision, SBMS, Dr. R. Pickholtz and the experts of Virginia Tech. agree that direct overlay sharing is not feasible. Teletrac's proposal is not a bona fide sharing proposal in that exclusive spectrum is required to implement its scheme. Teletrac, by its own admission, prefers the NPRM allocation scheme;
- Pinpoint implicitly admits that they must have exclusive spectrum access by advocating a time slicing regimen. Their system must have exclusive spectrum access during their time slice in order to function properly.

In sum, no credible party supports time slice or direct overlay sharing. Pinpoint has built a system which blatantly ignores the existing rules and Pinpoint and Hatfield's flawed analyses have clouded the record of this proceeding. Their claims conflict with known and basic scientific principles, as shown by the analyses of MobileVision and SBMS; their system will not function with other systems; and they cannot provide necessary and important ancillary services. MobileVision submits that its band plan for the spectrum, which very closely mirrors the NPRM, should be adopted by the Commission. All other commenters agree in principle with this assertion as shown clearly in the record; all others except Pinpoint. Throughout this proceeding, MobileVision has not supported SBMS' proposed band allocations of 4 MHz systems because of reduced capacity for location and necessary ancillary services. However, MobileVision submits that if MobileVision's proposal is not favored by the Commission and if the Commission believes time or direct overlay sharing facilitates multiple LMS providers, MobileVision would rather support allocation of three 5 1/3 MHz bands, even though it would reduce capacity, than be faced with sharing alternatives fatal to LMS services. In such an event, MobileVision's detail proposals would remain as stated in its Further Comments including provision for ancillary voice and data services and a safe haven for Part 15 users, but would be amended to reduce the band allocations to 5 1/3 MHz, each allocated exclusively to the LMS licensees. In addition to providing these three allocations, companies like Pinpoint who assert sharing with their system is possible, would be free to provide service on the remaining 10 MHz, thus assuring a minimum of four providers.

II. Shared or Direct Overlay

Direct overlay is a technique which entails the overlay of one operator's signal on that of another without regard for time or coordination. The result is interference between the two operators that is statistical in nature. Teletrac supports this approach while SBMS, Virginia Tech and MobileVision strongly disagree. Pinpoint finds elements of the plan attractive because they have misunderstood Teletrac's proposal to be one of time sharing, as noted in Teletrac's Reply Comments: "...many misunderstood its intent, its design and its effect."[1] Clearly, Teletrac feels that there must be rules which limit the amount of co-channel interference, and that there is need for exclusive spectrum as detailed in their comments which propose exclusive narrow band and wide band forward links.

Specifically, in its Reply Comments of March 29, 1994 Teletrac states:

> "Briefly summarized, Teletrac's proposal is that wideband LMS systems share return link spectrum between 904–910.5 MHz, with the *first two* (emphasis added) systems to construct and operate receiving co-channel protection. Sharing rules are limited and would apply only to the coordination of high powered housekeeping transmissions."[2]

It is clear from the above that Teletrac's proposal limits sharing to only *two* providers.

Teletrac further states that :"...wideband systems LMS systems require 8 MHz to provide a viable commercial system with adequate capacity and accuracy, in the 902–928 MHz frequency band."[3] MobileVision has supported and continues to support that contention. Thus, it is clear that Teletrac's "compromise" proposal advocating direct overlay sharing for two providers recognizes the need for some amount of exclusive spectrum. Ironically, Teletrac "...still far prefers the 2-8-6-8-2 MHz band segmentation proposed by the Commission."[4] Teletrac clings to the premise that 8 MHz is a

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[1] Reply Comments of Teletrac, March 29, 1994, p. 1
[2] *Id.*, p. 2
[3] *Id.*, p. 11
[4] Comments of Teletrac, March 15, 1994, p.2.

requirement for wideband LMS systems as indicated in its Reply Comments of March 29, 1994 at p.11: "...wideband systems LMS systems require 8 MHz to provide a viable commercial system with adequate capacity and accuracy, in the 902–928 MHz frequency band. Teletrac continues to hold to this position." Teletrac's "compromise" proposal contradicts its previous positions as is set forth in its Reply Comments of July 29, 1993 at p. 20 where they stated "...co-channel separation is a necessity for wideband pulse-ranging systems if they are to operate accurately and efficiently. Sharing regimes would seriously degrade LMS service and impose substantial costs without public benefit."

III. Time Sharing

Time sharing is a technique which attempts to share a resource in time. With this technique, stringent control over which system transmits at what time is crucial. Unlike direct overlay sharing where two (or more) systems may transmit at the same time on the same frequency band, time sharing systems permit only one operator access to the spectrum at a time, and during the period of time assigned to that operator, the allocated band is used exclusively. Based on the comments submitted both in March 1994 and June/July 1993, Pinpoint stands alone in support of such an approach. All other LMS respondents are in strong opposition. SBMS has stated in their Reply Comments of March 29, 1994, p. 17, that "If Pinpoint's time sharing scheme were adopted by the Commission, in all likelihood SBMS and other carriers would be forced to abandon their LMS efforts because no viable service could be deployed and marketed to the public." MobileVision agrees. MobileVision has stated in its March 15, 1994 Further Comments that "<u>The only information that has been presented in this proceeding based on actual experience with wideband pulse-ranging systems, establishes clearly that time sharing or frequency fragmentation results in loss of capacity, accuracy, required ancillary services and reliability. Such sharing, rather than increasing competition, would eventually render wideband LMS systems technically and economically nonviable</u>." Teletrac is crystal clear in its Comments of March 15,. 1994, p. 5 wherein it states that "Teletrac continues to believe that rigid time sharing rules would be inefficient, burdensome to enforce, and contrary to the public interest."

MobileVision is in the process of dealing with astute investors in the financial community. In the course of these contacts, it has been given one very clear message: no investor will infuse capital into any LMS provider if time sharing is mandated.